DOCUMENT RESUME

ED 053 796 PS 004 836

AUTHOR Sinclair, Caroline B.
TITLE Movement and Movement Patterns of Early Childhood.
INSTITUTION Virginia State Dept. of Education, Richmond. Div. of Educational Research and Statistics.
PUB DATE Jun 71
NOTE 25p.
AVAILABLE FROM Division of Educational Research and Statistics, State Department of Education, Richmond, Virginia 23216

EDRS PRICE EDRS Price MF-$0.65 HC-$3.29
DESCRIPTORS Age Differences, *Child Development, Growth Patterns, Individual Development, *Individual Differences, *Motion, *Motor Development, *Preschool Children, Sex Differences, Task Performance

ABSTRACT

This study was undertaken to determine the progressive development in movement and movement patterns (coordinated movements of body parts used involuntarily to achieve an objective) of children 2- to 6-years-old, to identify general characteristics which may be studied for appraisal of growth and development, and to study variations in movement among normal subjects in this age range. The study was conducted by observation, motion photography, and analysis of the performance of subjects in 18 to 25 movement tasks in each of six school semesters. Movement performance recorded on film was analyzed according to the Movement Task Analysis Form developed for each task. To establish a suitable context for determining movement development, the factors of age, sex, intelligence, maturity, teacher's estimate of achievement, and reading readiness were studied in relation to the subject's motor scores. Movement task scores were summarized for each age group. The study concluded that normal preschool children will perform a variety of movement tasks which are similar and which develop according to a predictable timetable; although motor performance and movement development vary with age, sex, and among individuals. Seven characteristics significant in the movement development of young children were identified. (Author/AJ)

ED053796

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY

MOVEMENT AND MOVEMENT PATTERNS OF EARLY CHILDHOOD

Caroline B. Sinclair, Ph.D.

PS 004836

Dr. Sinclair served as consultant and principal investigator for the Richmond City schools for this project. She formerly was head of the Health and Physical Education Department at Madison College.

Division of Educational Research and Statistics
State Department of Education
Richmond, Virginia 23216
June 1971

PURPOSE

The motor development of children and their success in movement have been stressed in three areas of study—education for the preschool years, treatment for brain-damaged children and under-achieving children, and perceptual-motor development. Movement patterns and their usual development from birth to age two have been well established by Geselle, McGraw and others. Norms for motor achievement of school-age children in a variety of activities have been reported by Espenschade, Carpenter, Johnson, and others; but little has been added to studies conducted in the 1930's to document the movement development of the normal child during the period from two to six years of age.

This study was undertaken to determine the progressive development in movement and movement patterns of children two to six years of age. Related objectives were to identify general characteristics which may be studied for appraisal of growth and development and to study variations in movement among normal subjects two to six years old.

PROCEDURE

Movement pattern is defined as a coordinated movement of body parts used involuntarily to achieve an objective. The pattern may emerge complete or be developed over a period of time. During the period of development the subject may or may not be acting voluntarily.

No effort was made in this study to involve volitional control of movement; instead, emphasis was placed on the goal to be achieved. Since the subjects were young and inexperienced, it is probable that movement patterns observed were those which emerged in the conscious effort of the child to achieve his purpose.

Movement tasks were selected as those activities commonly considered fundamental to the performance of more complex motor actions. In some instances they were adjusted to allow for age increases in size, strength, and skill.

An analysis form adapted from the Kephart[1] Movement Pattern Check List was used to record the performance for each movement task. A standard of success was established for each task, and a number of observable elements were checked as definitive of the way in which the subject performed. The elements for each task and criteria for success and mature pattern are as follows:

[1]Godfrey, B. B. and Kephart, N. C. *Movement Patterns and Motor Education*, pp. 161-170.

MOVEMENT TASK

Task	Elements of Task	Success & Mature Pattern
Ascending Stairs	Foot over foot Opposition No support Body faces forward Arms move forward-backward Climbs in a straight line Rhythmic and even movements Body well aligned Right or left preference indicated by leading foot	*Success*: able to ascend without resorting to all fours. *Mature pattern*: foot over foot with no marked deviations.
Bouncing (on a board)	Maintains balance Number of successive bounces Increases height Uses arms in elevation Uses ankles in flextion and extension Arms pause at or above shoulder level Rythmic and even movements	*Success*: four succesive bounces without help. *Mature pattern*: bounces with arms in elevation with no marked deviations.
Bouncing a Large Ball	Uses one hand Knee-to-waist height bounce Moderate speed Starts with both hands Moves with ball Covers space	*Success*: controls ball for four successive bounces. *Mature patterns* achieves six bounces and covers space at a walk or four bounces covering space with a run and no marked deviations.
Carrying	Bends knees to pick up weight Keeps object close to body Supports weight off floor all the way Compensates in shift of body Moves in a direct path Moves at a steady pace Trunk erect except compensation Controls weight in putting down Uses one hand	*Success*: supports the weight for the entire distance. *Mature pattern*: subject able to carry weight with one hand (suitcase style) entire distance with no marked deviation.

Task	Elements of Task	Success and Mature Pattern
Catching[2]	Places hands in readiness Lateral stance or adjusts feet Catches with one or both hands Gives to lessen impact Eyes open and focused Uses reaction of catch for return	*Success*: catches two of three trials. *Mature pattern*: makes catch without using arms to cradle ball.
Climbing	Uses arms in alternation Uses foot over foot action Uses opposition Body faces ladder Climbs to the top Movements steady and rhythmic Preference for left or right indicated by leading foot	*Success*: climbs to the second step from the top. *Mature pattern*: foot over foot action with no marked deviation.
Creeping	Uses arms alternately Uses legs alternately Uses limbs in opposition Uses opposition Points hands forward Keeps feet off floor Keeps back level Controls direction	*Success*: covers expected distance on hands and knees (or feet). *Mature pattern*: uses limbs in opposition with no marked deviations.
Descending Stairs	Foot over foot action Uses no support Body faces forward Arms used for balance Preference for right or left indicated by supporting foot on descent Arms used in opposition Descended in straight line Rhythmic and even movement Body well aligned	*Success*: able to descend in the erect position without help. *Mature pattern*: use of foot over foot action without obvious defection.
Figure-Eight-Run	Starts promptly Runs first to own right Alternates direction Maintains balance Maintains speed Stays close to obstacles Uses arms for balance Follows course Shows evidence of motor planning	*Success*: covers the course in any order. *Mature pattern*: completes the circuit with one or more cross-overs and maintains balance and speed.

[2]At ages five and six a tennis ball was substituted for the playground ball used by younger subjects.

Task	Elements of Task	Success and Mature Pattern
Forward Roll	Hands point ahead Uses hands for partial support Tucks head Rounds back Flexes knees and hips Rolls straight Comes to feet from roll	*Success*: subject goes over. *Mature pattern*: goes over with head tucked and back rounded.
Galloping	One foot leads Faces forward Can change lead foot Rhythmic and steady Uses arms in balance Staccato movement	*Success*: maintains a recognizable gallop. *Mature pattern*: demonstrates the gallop in a steady rhythm with no marked defect.
Hanging	Assumes position without help Uses overgrasp Holds position 4-20 seconds Head and shoulders normal Arms straight Gets down without help	*Success*: supports own weight by hands in hanging position for at least four seconds. *Mature pattern*: maintains the hanging position for ten seconds with no marked deviations.
Task Hitting	Contact in three trials Sideward stance *Shifts weight in preparation *Shifts weight in hitting *Uses body rotation Controls direction *Follows through Contacts ball squarely Hits right-left (or left-right) Uses both hands	*Success*: hitting the ball. *Mature pattern*: uses a real transfer of weight (at least two of the starred elements).
Hopping	Hops at least four times in succession Hops in straight line Hops on preferred foot Holds free foot up to rear Uses arms for balance Able to hop on either foot	*Success*: four successive hops. *Mature pattern*: six hops (or completed distance) with the free foot held up and to the rear.
Kicking[3]	Moves toward ball Contacts ball with foot Times backswing for kick Uses limbs in opposition Uses same foot each trial Extends knee in kicking Contacts ball squarely Controls direction Moves in direction of kicked ball	*Success*: kicks the ball forward its full circumference or more. *Mature pattern*: kicks the ball from a backswing (moving both arms forward sideward for balance) or in the stride of a run with arms moving in opposition.

Task	Elements of Task	Success and Mature Pattern
Pulling	Moves obstacle the full distance Hands placed in "pull" position Exerts force in line with resistance Uses legs and/or arms Keeps contact with object Applies force steadily after start Controls direction Adjusts body Uses wide, open stance at start	*Success*: moves obstacle (bench with rider) the full distance. *Mature pattern*: success with body adjustment and no marked faults.
Pushing	Moves obstacle the full distance Places hands in "push" position Exerts force in line with resistance Adjusts body Uses legs and/or arms Keeps contact with object Applies force steadily after start Controls direction Uses wide, open stance at start	*Success*: moves object (bench with rider) the full distance. *Mature pattern*: success with body adjustment and no marked faults in performance.
Running	Covers the full distance Inclines body forward at start Symmetry in leg action Symmetry in arm action Uses limbs in opposition Elbows are well bent Lifts knees well in front Controls direction Toes point ahead Uses ball-of-foot contact	*Success*: runs the measured distance. *Mature pattern*: uses opposition while running.
Running High Jump	Clears the bar in a leap or jump Checks run on approach Takes off from one foot Lowers center of gravity over bar Uses arms for elevation Accelerates opposition arm with trailing foot Lands on one foot Controls landing	*Success*: clears the bar at any height. *Mature patttern*: success with take-off preceded by leading elevation of both arms and no marked faults.

[3]Ball stationary at ages two and three, rolling at ages four to six.

PS 004836

Task	Elements of Task	Success and Mature Pattern
Skipping	Covers the prescribed distance Alternates feet evenly Uses arms for balance Uses limbs in opposition Uses ball of foot Moves in direct path Rhythmic and steady Shows no difference right and left	*Success*: at least four successive skips. *Mature pattern*: covers the prescribed distance with steady rhythmic skip.
Sliding	Four or more successive slides Maintains body facing forward Leads with one foot Uses arms for balance Controls direction Rhythmic and steady Can lead with either foot Can change direction	*Success*: Four or more slides with right or left foot leading. *Mature pattern*: successful over the prescribed distance with steadiness and consistent rhythm.
Standing Broad Jump	Covers space forward Takes off from mark Uses arms in preparation Uses arms forward, upward direction Uses two-foot take-off Bends knees well in preparation Controls landing forward Accelerates with legs in air	*Success*: uses a true jump (two-foot take-off) to cover space. *Mature pattern*: success with the arms leading in paired movement.
Throwing (small ball)	Projection of the ball Sideward stance *Shifts weight in preparation *Uses body rotation Throws with right hand (or left) Uses overarm throw Is consistent in style *Follows through Cocks and uses wrist	*Success*: projects ball forward. *Mature pattern*: success using two or more starred elements.
Walking	Covers the distance Alternates legs symmetrically Uses arms for balance Uses limbs in opposition Toes ahead Walks in straight line Heel strikes ground first Body is well aligned	*Success*: covers the distance with a walk. *Mature pattern*: symmetrical use of arms and legs with no marked faults.

Task	Elements of Task	Success and Mature Pattern
Walking the Beam[4]	Walks full length (eight feet) Keeps feet on beam Uses arms for balance Toes ahead Moves forward continuously Moves forward at steady pace Uses arms in opposition Eyes focus ahead	*Success*: walks the full length of the beam with not more than one step off. *Mature pattern*: subject moves forward toeing ahead and using arms for balance as needed

Sample

Subjects were chosen by age, availability, and normality attested to by medical examination, psychological test, and teacher's estimate. The subjects ranged in age from two years and one month to four years and eleven months at the time of enrollment. The oldest group, which started at four years, was continued into the first semester of the first grade.

Where possible, the 44 subjects originally enrolled were retained in the study for each of six successive school semesters (designated Phases One to Six). A second group of 13 two-year-olds was enrolled in the study in Phase Three to give a larger number of children of this age for the study. In Phases Five and Six only children previously enrolled in the study were included.

The number of subjects who completed tasks at each age is shown in Table 1. For purposes of grouping, the child's age on October 1 was considered his age for that school year.

TABLE 1
RETENTION OF SUBJECTS BY AGE

	Number of Subjects Enrolled	Number of Subjects Completing All Tasks	Percentage of Subjects Completing All Task
Age 2	30	23	77
Age 3	29	26	90
Age 4	31	28	90
Age 5	25	24	96
Age 6	18	18	100

[4]At ages five and six a two-inch walking beam replaced the four-inch beam used by younger subjects.

Collection of Data

The study was conducted by observation, motion photography, and analysis of the performance of subjects in 18 to 25 movement tasks in each of six school semesters.

In the first phase, before the movement tasks were filmed, a baseline was established by observing each child and recording in detail the performance of each of the 18 movement tasks which were selected as fundamental.

The children were grouped by age for assignment of motor tasks. They were listed by chronological age (youngest to oldest) within each group so that the investigator might be constantly reminded of age differences.

Anolysis of Movement Development

Movement performance recorded on film was shown in slow motion and was analyzed by using the Movement Task Analysis Form developed for each task. To determine the reliability and validity of this method, a section of 150 feet of film from Phase One was analyzed by the investigator, and then sent with analysis forms to three physical educators who were selected for their special qualifications in analyzing human movement: Dr. Lawrence Rarick, of the University of Wisconsn; Dr. Barbara Godfrey, of the Unversity of Missouri; and Dr. Helen Eckert, of the University of California at Berkley. The analyses of the investigators and of the three selected physical educators were studied and compared by Dr. Patricia Bruce and Dr. Leotus Morrison of Madison College. A frequency count of the disagreements of each reviewer with the analysis of the investigator showed a total of 50 disagreements in 600 responses (8.3 percent).

After the analysis of movement tasks was completed, scores were assigned to each child for each task. The system of scoring, applied in each phase of the study, was:

5 = successful and all elements exhibited

4 = successful and all elements except one exhibited

3 = successful and conforming to mature pattern of movement

2 = successful but not meeting standard

1 = partially and objectively successful and to a marked degree

The subject's motor score for Phase One equaled the sum of the 18 movement task scores. To equate the motor score for a varying number of tasks in other phases, the total movement task score for that phase was multiplied by 18 and divided by the number of tasks performed in that phase.

General Factors Related to Movement Development

To establish a suitable context for determining movement development, the factors of age, sex, intelligence (I.Q.), maturity (D.Q. established from Geselle Development Examination), teacher's estimate of achievement, and reading readiness (Metropolitan Reading Readiness scores) were studied in relation to the subject's motor scores.

Movement Characteristics

Characteristics common to many movement tasks which were selected for special study included:

1. Dominance (side preference for paired parts)
2. Opposition (the synchronized use of opposite hand and foot in the upright position and cross-laterally in quadipedal movement) and symmetry (including foot-over-foot action in climbing and descending)
3. Dynamic balance (the ability to maintain equilibrium while moving)
4. Total body assembly (using the parts of the body as levers to acquire speed or force against resistance or for power release in a combination of speed and force)
5. Rhythmic two-part locomotion (as in gallop, slide, skip)
6. Eye-hand efficiency in manual response to a static or or moving object
7. Agility (maneuverability of the body)
8. Postural adjustment

At the end of each phase, task analysis records were reviewed to ascertain the appearance of these characteristics. The data were analyzed to determine the relationship of each characteristic to movement development as represented by motor score.

Individual Differences

Individual case studies were developed to aid in the study of variations among the subjects. A special analysis was conducted for the subjects with the greatest positive and negative deviations from the mean of motor scores.

RESULTS AND DISCUSSION

MOVEMENT DEVELOPMENT FOR AGES TWO TO SIX

Movement task scores are summarized for each age group in Table 2. A score of zero indicates that no child was successful, and a missing score indicates that the particular task was not observed at that age.

Table 2

MEANS OF SCORES FOR MOVEMENT TASKS BY AGE

	Age 2	Age 2.5	Age 3	Age 3.5	Age 4	Age 4.5	Age 5	Age 5.5	Age 6
Ascending stairs	2.3	2.4	3.3	3.1	4.5	—	—	4.2	4.3
Bouncing on board	1.2	2.1	2.0	2.9	2.5	3.1	—	—	—
Bouncing a ball	—	—	—	1.6	—	2.8	—	3.6	3.6
Carrying	3.3	2.1	3.3	2.4	3.6	4.0	3.7	2.8	3.8
Catching	1.2	2.1	2.3	2.5	2.4	2.5	1.9	1.6	2.1
Climbing	1.8	2.6	2.6	2.5	3.1	3.3	3.0	3.3	3.9
Creeping	2.9	3.6	3.2	3.6	3.8	3.4	3.4	3.1	3.7
Descending stairs	1.7	2.0	2.2	2.5	3.0	3.1	2.7	3.0	3.9
Figure-eight-run	—	—	—	.5	—	1.8	—	2.4	2.9
Forward roll	1.8	2.0	2.2	2.9	2.3	2.4	3.1	2.7	2.6
Galloping	2.1	2.0	1.8	2.4	3.3	2.7	3.3	4.0	4.2
Hanging	1.9	—	2.3	2.8	3.0	3.0	3.0	3.6	3.2
Hitting	0.8	2.8	1.4	2.2	1.3	2.7	1.9	2.0	2.4
Hopping	0	.2	.7	1.9	2.4	3.3	3.2	4.3	3.3
Kicking	2.3	2.3	2.6	2.2	2.8	2.4	3.2	2.9	2.8
Pulling	2.2	2.4	2.5	1.8	3.8	3.8	3.6	3.0	3.4
Pushing	2.2	3.7	3.1	2.8	3.2	4.1	4.1	3.2	3.4
Running	2.0	2.3	2.7	2.5	3.2	3.0	3.6	3.5	3.3
Running high jump	.4	.9	1.6	2.2	2.5	4.0	3.3	3.3	3.1
Skipping	0	.2	1.9	.5	1.7	2.9	2.1	2.7	3.1
Sliding	0	0	1.0	1.4	2.4	2.9	2.8	4.6	4.1
Standing broad jump	1.8	3.6	2.6	3.3	3.3	3.0	3.8	3.6	3.7
Throwing	2.1	2.3	2.9	2.7	3.0	2.8	3.1	3.2	3.8
Walking	2.9	2.5	3.2	3.1	3.1	3.4	3.3	2.9	3.7
Walking a beam	.1	1.4	2.3	2.7	3.2	2.9	1.9	2.0	2.4
Mean for all tasks	31.0	43.5	40.5	45.5	51.6	51.6	52.2	55.4	60.9

Movement Development at Age Two

At age two children are able to explore the environment in an upright position and to move freely from place to place. Their balance is facilitated by a wide stance and out-thrust arms. They pull, push, drag, and carry objects with them in their play. Since falls are frequent, they tend to carry their arms up and forward so that they can break the fall if they lose their balance. Because vocabulary and experience are limited, telling them must often be replaced by showing. Two-year-olds are eager to try new tasks, but will refuse or change a movement task which they deem too difficult.

At age two the subjects in this study were successful in performing 16 of the 23 movement tasks assigned them (bouncing a ball and the figure-eight-run were not included) ; i.e., in each of the 16 tasks more than 60 percent of the subjects performed successfully,[5] or the mean score was two or better. They were especially proficient in carrying and creeping. Though they were unsuccessful in most instances, the two-year-olds attempted to hit a ball and walk a beam. They executed their own version of gallop, a running high jump, a skip, and a slide, but seldom attempted a hop. Although girls scored higher than boys in 15 of 23 tasks, the difference between the means of the motor scores was small (girls 23.3, boys 23.1).

A. Selected Characteristics of Movement Tasks, Age Two

1. All two-year-olds demonstrated a preference for using the right hand for throwing and the right foot for kicking, but there were occasional variations in the use of hand or foot (10 percent frequency).

2. Two-year-olds displayed opposition in vigorous running, and this characteristic sometimes appeared in walking (46 percent successful) or in kicking a ball (50 percent successful). They were not likely to use opposition in creeping or climbing or the foot-over-foot pattern in ascending or descending stairs.

3. The two-year-olds mantained their balance by a slightly widened stance and by using their arms. They controlled their bodies on the bounce board but were unable to maintain balance on the four-inch walking beam.

4. The subjects did not demonstrate effective total body assembly in hitting or throwing. They used it occasionally in the standing broad jump,[6] and they mobilized their strength well in pushing (63 percent incidence) and to a lesser degree in pulling and carrying.

---

[5]In the following discussion, the indicated percent refers to the percentage of subjects who performed successfully.

---

[6]Two-year-olds were unable to manage a two-foot take-off from a mark but could do so from an elevation.

5. Some of the subjects were able to gallop, but they could not slide or skip. The subjects were consistant in the choice of leading foot and were evenly divided between left and right leads.

6. Eye-hand efficiency was demonstrated by catching a large ball (67 percent successful) and by hitting a ball with a mallet or bat when the ball was stationary (46 percent successful).

7. Their agility was low as shown by the percentage of those executing the forward roll with a tucked head and rounded back (23 percent).

8. At two the subjects usually displayed good body alignment in walking, running, and jumping.

Movement Development at Age Three

The period from age two to age three was one of rapid movement development. At three the children had progressed toward a more mature pattern in most motor tasks, and they were able to refine their movements and mobilize their body parts for more effective use. In addition to the motor tasks performed at age two, they were able to walk on a four-inch beam successfully, gallop while leading with the preferred foot, and perform the standing broad jump from a mark, usually with a two-foot take-off and landing. They were sometimes able to bounce a large ball several times. This was not tested at age three, but 63 percent were successful at age three and a half.

A. Selected Characteristics of Movement Tasks, Age Three

1. With the exception of four cases of preference for the left foot, the subjects showed a preference for the right hand and right foot.

2. There was improvement in opposition of 32 percent in creeping (from 23 percent at age two to 55 percent at age three) and 27 percent in climbing (from three percent at age two to 30 percent at age three).

Eighty-nine percent of the three-year-olds ascended stairs and 55 percent climbed a ladder foot-over-foot. Only a few descended stairs in this manner, however. In walking the pattern of opposition increased to 59 percent (from 46 percent at age two), but there was little change in running and kicking.

3. A gain in dynamic balance was demonstrated by proficiency on the four-inch walking beam by 65 percent of the three-year-olds and by a gain of 10 percent in success on the bounce board.

4 Total body assembly was demonstrated for speed in hitting by 52 percent of the children. The use of total body assembly increased for pushing (63 percent at age two, 83 percent at age

three) and pulling (52 percent at age two, 79 percent at age three). Gains were noted for the broad jump, the high jump, and the carry, but the incidence for these tasks was not above 50 percent.

5. Rhythmic two-part locomotion was demonstrated by 76 percent of the children in galloping, by 34 percent in sliding, and 12 percent in skipping.

6. Eye-hand efficiency increased for catching a ball (from 67 percent at age two to 79 percent at age three) but was unchanged for hitting a ball.

7. Agility, though not yet prevalent in the forward roll, was demonstrated by 35 percent of the subjects compared with 23 percent at age two.

8. Postural adjustment in the selected activities showed little change from age two, although there was an 11 percent decrease in walking alignment (from 73 percent at age two to 62 percent at age three).

Movement Development at Age Four

The year from age three to age four was marked by further growth in size, strength, and motor effectiveness, particularly in rhythmic locomotion and balance, in the method of descending stairs, and in ability to jump over a bar.

At age four the mean of scores from 21 of 23 movement tasks was 11.1 points higher than at age three.

Inept in these tasks at age three, the four-year-olds were able to hit a stationary ball, slide, skip, hop, and do the running high jump. Although 58 percent of them could lead with either foot in the gallop, only 13 percent could hop on the nonpreferred foot. At age four all of the pupils were successful in walking on the four-inch beam, but the two-inch beam was too difficult for them. They used their arms for balance and greater elevation on the bounce board. They were able to kick a rolling ball successfully. At four and a half years, 75 percent were successful in the figure-eight-run with a mean score of 1.8 (compared with nine percent successful and a mean of .5 at three and a half years). Boys performed better than girls in the standing broad jump and in throwing. Girls were slightly superior to boys in the running high jump and in the 50-foot run according to distance and time, but boys made higher scores in method of performance.

A. Selected Characteristics of Movement Tasks, Age Four

1. All but six subjects demonstrated right dominance. The single instance of left-hand right-foot preference at four years was resolved as consistent left preference for both hand and foot at ages five and six.

2. The four-year-olds showed the greatest gains for opposition in using the foot-over-foot pattern in descending stairs (12 percent at age three, 84 percent at age four). Other changes varied from a loss of 10 per cent in creeping (55 percent at age three, 45 percent at age four) to a gain of 10 percent in the foot-over-foot pattern in climbing a ladder (55 percent at age three, 65 percent at age four).

3. There also was improvement in dynamic balance. All subjects were successful on the four-inch beam (65 percent at age three), 83 percent were successful on the bounce board (70 percent at age three), and 71 percent were successful in hopping (28 percent at age three).

4. The four-year-olds showed gains for speed in throwing (from 24 percent at age three to 48 percent at age four), for power in the standing broad jump (from 50 percent at age three to 64 percent at age four) and the running high jump (from 45 percent at age three to 80 percent at age four), and for force in pulling (from 72 percent at age three to 90 percent at age four) and carrying (from 48 percent at age three to 84 percent at age four). Losses of 17 percent for hitting and 12 percent for pushing were also noted. The ankle was used more often in jumping and running than at age three but not with great frequency or consistency. The well-bent elbow and lifted knee also were observed more frequently in jumping at age four than at age three.

5. Gains in rhythmic two-part locomotion were apparent in galloping (from 76 percent at age three to 92 percent at age four), in sliding (from 34 percent at age three to 77 percent at age four), and in skipping (from 12 percent at age three to 52 percent at age four). A 58 percent success rate was noted in the ability to use either foot as a lead in galloping (14 percent at age three), with some preference for a right-foot lead.

6. Eye-hand efficiency improved, as exhibited in catching a large ball (from 79 percent at age three to 94 percent at age four), in hitting a ball (from 48 percent at age three to 58 percent at age four), and in bouncing a ball (from 63 percent at age three to 100 percent at age four).

7. Agility, as evidenced in the favored roll, increased from 35 percent at age three to 42 percent at age four and, as evidenced in the figure-eight-run, increased from zero at three and a half years to 25 percent at four and a half years.

8. Postural adjustment remained high, as shown by a percentage score gain in walking (from 62 percent at age three to 77 percent at age four), in running (from 72 percent at age three to 94 percent at age four), and in the standing broad jump (from 76 percent at age three to 81 percent at age four).

Movement Development at Age Five

Progress in movement development was paralleled by increased size, strength, and experience which provided a more confident approach to the movement tasks, with which the children were familiar. Greater challenge was added by providing a small ball (tennis ball) for catching and a two-inch beam for walking. Four movement tasks were measured in units of time or distance. The bounce on the board was eliminated because of the greater weight of five-year-olds

All of the 19 familiar tasks were performed successfully (descending stairs, bouncing a ball and the figure-eight-run were not tested at age five). Sixty percent of the subjects were successful in catching the small ball, the mean score of 1.9 indicating a sharp decrease from the proficiency attained earlier with the large ball. Only 56 percent of the children at age four were successful in performing their task when the width of the walking beam was reduced from four to two inches. At five and a half years the mean score was 2.4 in the figure-eight-run (80 percent successful) and 3.6 in the ball bounce (100 percent successful).

Boys attained a major gain in the distance they threw a ball (a mean score of 44.63 feet) at five and a half years, while girls made lesser gain (a mean score of 25.07 feet). Boys also showed a greated gain for the standing broad jump, while girls made a greater gain in the running high jump. Girls showed no improvement in the 50-foot run, while boys showed some improvement.

A. Selected Characteristics of Movement Tasks, Age Five

Steady achievement in the selected movement characteristics was typical of development from ages two to four, and the rate of progress appeared as great, but more varied, from four to five years. Notable but erratic improvement was made in opposition and symmetry, and achievement was evident in total body assembly, dynamic balance, rhythmic two-part locomotion, and agility.

1. Most of the children preferred to use the right hand and right foot. One child, however, used the left hand and left foot consistently, and one preferred to use the left hand and the right foot. Three were uncertain or inconsistent in their preference.

2. Small gains were made in opposition in walking, running, kicking, and skipping. No significant change occurred in creeping.

3. Gains in dynamic balance were demonstrated in hopping (from 71 percent at age four to 96 percent at age five) and for hopping on the nonpreferred foot (from 13 percent at age four

to 96 percent at age five). Fifty-six percent of the children were successful in walking the two-inch beam.

4. In total body assembly improvement was noted in speed in hitting (35 percent at age four, 60 percent at age five) and in throwing (48 percent at age four, 68 percent at age five), and for power in the standing broad jump (64 percent at age four, 76 percent at age five) and the running high jump (80 percent at age four, 88 percent at age five). Gains in force for pushing and pulling were not significant. There was considerable loss in carrying (84 percent at age four, 64 percent at age five). When running, most subjects bent their elbows and lifted their knees frequently but inconsistently. About half of the children ran on the ball of the foot.

5. Gains in rhythmic two-part locomotion were indicated by a 10 percent improvement in leading with the nonpreferred foot in galloping, 23 percent in sliding, 75 percent in the use of either direction in sliding, and 37 percent in skipping.

6. Eye-hand efficiency in catching a small ball was achieved by 60 percent of the subjects.

7. Agility, demonstrated in the forward roll, increased substantially (from 42 percent at age four to 64 percent at age five). In the figure-eight-run, the increase was from 25 percent at age four to 40 percent at age five and a half

8. Postural adjutsment gains were noted in walking (77 percent at age four, 84 percent at age five), in running (94 percent at age four, 100 percent at age five) and in the standing broad jump (81 percent at age four, 96 percent at age five).

Movement Development at Age Six

Mean scores for subjects at age six indicated success in all of the 24 movement tasks. Mean task scores ranged from 2.1 to 4.3 with a mean motor score of 60.9. Examination of the scores showed some loss in seven of the 24 movement tasks. The number of children who were successful in hitting a ball and walking on a beam increased, while mean scores showed marked improvement (.5 or more) in climbing, descending stairs, figure-eight-run, galloping, hitting, skipping, sliding, and throwing. Those tasks in which losses of .5 or more occurred were the forward roll and pushing (see Table 2).

Sex differences were more apparent, the correlation of motor score with male sex being notably higher (.41) than at previous ages. The greatest difference between scores for boys and girls was in throwing, where the mean distance was 31.91 feet for girls and 57.37 feet for boys, and the mean motor score

was 3.0 for girls and 4.6 for boys. The motor score for all tasks was 64.0 for boys and 57.7 for girls.

A. Selected Characteristics of Movement Tasks, Age Six

Improvement in the selected characteristics from age five to age six was inconsistent. In 29 variables checked for the seven characteristics, 21 showed gains, seven showed losses, and one was unchanged. Gains were consistent in dynamic balance, rhythmic two-part locomotion, and in total body assembly for speed and power.

1. The six-year-old children demonstrated right dominance of hand and foot with only three exceptions. Of the three, one was completely left dominant, one was mixed (left hand, right foot) and the third still evidenced uncertainty.

2. There were gains in opposition in running (from 91 percent at age five to 100 percent at age six), in skipping (from 16 percent at five to 44 percent at age six), and in creeping (from 44 percent at age five to 56 percent at age six). A slight loss occurred in kicking (from 72 percent at age five to 55 percent at age six), but no change occurred in walking.

3. For dynamic balance, improvement was noted on the balance beam. All six-year-olds used either foot successfully in hopping.

4. Total body assembly was apparent as a developing characteristic for speed in hitting (72 percent at age five, 88 percent at age six) and in throwing (76 percent at age five, 83 percent at age six), for force as exhibited in pulling (92 percent at age five, 100 percent at age six) and pushing (76 percent at age five, 100 percent at age six), and for power as demonstrated in the standing broad jump (from 76 percent at age five to 83 percent at age six) and the running high jump (from 88 percent at age five to 94 percent at age six). In running, the range of action at the knee showed little change, but there was less running on the ball of the foot.

5. In rhythmic two-part locomotion the six-year-olds were all successful in skipping and sliding with either right or left foot leading, and they showed improvement in the use of the nonpreferred foot in galloping (68 percent at age five, 83 percent at age six).

6. Greater eye-hand efficiency was demonstrated in catching (60 percent at age five, 72 percent at age six) and in hitting a ball (52 percent at age five, 78 percent at age six), but two subjects were unsuccessful in the ball bounce.

7. Agility was less evident at six years than at five years

in the forward roll (64 percent at age five and 41 percent at age six).

8. Postural adjustment was less satisfactory at six years than at five years as shown by a decrease in the success rate for walking (from 84 percent at age five to 67 percent at age six), for running (from 100 percent at age five to 89 percent at age six), and for the standing broad jump (from 96 percent at age five to 89 percent at age six).

Individual Differences — Ages Two to Six

There was a wide range of motor scores which indicated variation in success and in characteristics of movement tasks from age to age and within age groups. Scores of zero appeared at two years for some subjects in all movement tasks except walking and throwing, but only in hopping, skipping, and sliding did all two-year-olds score zero. Some scores of zero appeared at age six; but, with one exception, each subject scoring zero on a movement task at six years had previously scored two or better on that task

Variations in movement characteristics also occurred at all age levels and for individuals at various observations. For example, opposition in walking was demonstrated by eight subjects at age two, but only three of them used it at two and a half years.

Boys and girls were found in the high and low extremes in equal numbers. Subjects in the low scoring group tended to make low scores in all tasks, but deficiencies were noticeably frequent in balance activities, in eye-hand efficiency (especially in catching), in rhythmic locomotion, and in total body assembly for power.

Dramatic improvement sometimes occurred: one subject gained in motor score from 32 at two years to 66.2 at two and a half years, and another gained from 41 at four and a half years to 66.2 at five years. No loss this great was observed, but decreases of up to 18 points did occur from one testing period to another.

Relation of General Factors to Movement Development

A basic asumption of this study was that movement is a developing process during the early years of childhood. This assumption was supported by the increase in motor scores from ages two to six (Tables 3 and 4), by the development and maturation of movement patterns during these years, and by positive correlations between age and motor scores at all ages.

Table 3

MEANS OF SCORES BY PHASE, AGE AND SAME AGE GROUP

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Mean of Motor Score for Age
Age 2	32.1		30.0				31.0
Age 2½		43.8		43.3			43.5
Age 3	38.4		46.4		38.4		40.5
Age 3½		46.2		48.8		42.5	45.5
Age 4	52		52.8		49.2		51.6
Age 4½		51.6		51.8		50.8	51.6
Age 5			53.4		48.5		52.2
Age 5½				54.9		57.5	55.4
Age 6					60.9		60.9

Table 4

MEANS OF MOTOR SCORES BY AGE AND SEX

	At 2	At 3	At 4	At 5	At 6
Boys	28.1	39.3	53.3	56.0	64.0
Girls	32.3	41.2	50.0	50.6	51.9
Both	31.0	40.5	51.6	52.2	60.9

Correlations between motor scores and sex, I.Q., D.Q., teacher's estimate, and reading readiness generally were not significant at the .05 level. Teacher's estimate and D.Q. at age three were correlated with motor scores at the .05 level of significance.

The correlation of motor scores with male sex approached significane at age six. A comparison of the means of motor scores for girls and boys revealed a difference in favor of girls at ages two and three, and in favor of boys at ages four, five, and six. Girls surpassed boys in the performance of 15 of 23 tasks at age two, but were surpassed by boys in 17 of 25 tasks at age four.

Statistical Analysis of Movement Characteristics

In order to test the selected movement characteristics as indicators of movement development, they were studied in relation to motor scores. Those characteristics which were correlated with motor scores at or near the .05 level of significance are presented in Table 5.

Table 5

CORRELATIONS BETWEEN MOTOR SCORES AND MOVEMENT CHARACTERISTICS

MOVEMENT CHARACTERISTICS	Age 2	Age 3	Age 4	Age 5	Age 6
Dynamic Balance					
walking beam	.603			.517	.372
hopping		.573	.352		
Total Body Assembly (Speed)					
hitting	.359	.435	.459		.454
throwing		.316	.306		
Total Body Assembly (Power)					
standing broad jump	.452		.499		
high jump		.454		.442	
Total Body Assembly (Force)					
pushing				.480	
pulling	.520	.344			
carrying	.428		.395		
Rhythmic Locomotion					
sliding		.595	.344		
galloping			.484	.332	
skipping	.352				
Opposition and Symmetry					
climbing		.322	.504		
descending stairs				.602	
running	.344		.432		
kicking			.394		.344
Postural Adjustment					
walking		.354			.549
Eye-Hand Efficiency					
catching		.354	.333	.474	
hitting				.455	
Agility					
forward roll				.371	
figure-eight-run					.465
Minimum Correlation coefficient significant at the .05 level (r)	.349	.355	.347	.381	.444

SUMMARY

1. Movement development was positively related to chronological age. The variation of motor scores with age was found at all age levels, but a difference of a few months was less significant at age four and after than at ages two and three. The relationship of age to motor development was especially evident in: (a) dynamic balance, (b) eye-hand efficiency, (c) total body assembly, and (d) rhythmic locomotion. When children are classified into age groups, teachers and parents need to be especially aware of the age differences within groups.

2. Assessment of movement development included: (a) judging the success of a subject in specific movement tasks, (b) recording the elements involved in the movement when the subject attempted the task and reviewing the record for the absence or presence of selected movement characteristics, and (c) evaluating these findings in terms of the movement pattern and the results achieved.

The subjects progressed with varying but definite steadiness in their ability to perform successfully the 25 movement tasks. Mature pattern, defined separately for each of the tasks, was indicated by a task score of three or better. This score was reached in most tasks by both boys and girls at age five, but it was not reached at any age studied in catching and hitting. Since these tasks involve seeing, judging, and acting, they necessitate a variety of integrated responses for which more preparation and experience may be needed than is usually attained by age six.

3. Norms can be established for movement development. As defined in this study, movement development may be described for each age level. However, the performer and performance described is always hypothetical, since the performance represents the mean for all the subjects at that age.

4. There was much variation among preschool subjects in movement development. Scores for individuals also varied from one observation to another.

5. Movement scores tended to be greater for girls than for boys at ages two and three, while boys scored higher after age four. Sex differences appeared in several motor tasks. Girls scored higher in jumping, rhythmic locomotion, and balance tasks, while boys scored higher in catching and in those tasks requiring strength and speed. The greatest difference occurred in throwing with boys scoring higher than girls at age three and at succeeding ages. Other sex differences were more often exhibited at age four and later. As has been suggested by Hicks and others, social environment may account in part for these

sex differences, but sex-linked genetic influence must be suspected when the disparity is great; e.g. in throwing.[7]

6. Basic movement patterns are established in early childhood. Movement patterns were easily identified by the similarities with which children of a given age executed the movement tasks.

7. Seven of the eight movement characteristics selected for special study appear to be useful either singly or in combination as predictors of motor performance or as indicators of movement development (Table 4).

9. Further study is needed to determine suitable curricula and teaching and evaluative methods for the educational use of movement experiences for young children. Since this study is limited in number of subjects, geographical area, and study conditions, it is recommended that the descriptions given for each age be subjected to further research.

CONCLUSIONS

1. Given motivation and opportunity, [illegible] school children will perform a variety of movement t[illegible]sfully and will use movement patterns which are sim[illegible] which appear or develop according to a predictable time t[illegible]e.

2. Motor performance and movement development vary with age, sex, and among individuals.

3. Two criteria appear effective for the evaluation of a young child's development: (1) his progress over a period of time and (2) his achievements and patterns as compared with those of other children his age.

4. Seven characteristics have been identified which appear to be significant in the movement development of young children: (1) dynamic balance, (2) opposition and symmetry, (3) total body assembly, (4) rhythmic locomotion, (5) eye-hand efficiency, (6) agility, and (7) postural adjustment.

Bibliography

1. Barsch, Roy H. Perceptual Motor Efficiency, *Perceptual Motor Curriculum*, Vol. I, Seattle, Washington: Special Child Publications, Seattle Sequin School, 1967.
2. Bayley, Nancy. The Development of Motor Abilities during the First Three Years, *Monograph of the Society for*

[7]Hicks, J. Allan. The Acquisition of Motor Skill in Growing Children: CHILD DEVELOMENT. 1:90-105, 1930.

Research in Child Development, Washington, D. C.: 1935, 1, 1-26.

3. Carpenter, Aileen. Measurement of General Motor Capacity and General Motor Ability in the First Three Grades. *Research Quarterly,* 1942, 13, 444-465.
4. Chaney, Clara M. and Kephart, Newell C. *Motoric Aids to Perceptual Training.* Columbus, Ohio: Charles E. Merrill Company, 1968.
5. Cooper, John M. and Glassow, Ruth B. *Kinesiology* St. Louis: C. V. Mosby Company, 1963.
6. Cratty, Bryant J. *Movement Behavior and Motor Learning.* Philadelphia: Lea and Febiger, 1964.
7. Diem, Liselott. Basic Movement Education with Simple Elements in Primary Schools, *Ninth International Congress Report.* Washington, D. C.: International Council on Health, Physical Education and Recreation, 1967.
8. Espenschade, Anna S. and Eckert, Helen M. *Motor Development.* Columbus, Ohio: Charles E. Merrill Company, 1967.
9. Gesell, Arnold L. *The First Five Years of Life.* New York: Harper, 1940.
10. Godfrey, Barbara B. and Kephart, Newell C. *Movement Patterns and Motor Education.* New York: Appleton, Century, Crofts.
11. Gutteridge, Mary V. A Study of Motor Achievements of Young Children, *Archives of Psychology,* Columbia University, 1939, No. 244.
12. Galverson, Lolas E. *A Comparison of Performance of Kindergarten Children in the Take-Off Phase of the Standing Broad Jump.* Doctoral dissertation, University of Wisconsin, 1958.
13. Hanson, Margie R. *Motor Performance Testing of Elementary School Age Children.* Unpublished doctoral dissertation, University of Washington, 1965.
14. Hicks, J. Allan. The Acquisition of Motor Skill in Young Children: A Study of the Effects of Practice in Throwing at a Moving Target, *Child Development.* 1930, 1, 90-105.
15. Ilg, Frances and Ames, Louise Bates. *Child Behavior.* New York: Harper, 1955.
16. Johnson, Robert D. Measurements of Achievement in Fundamental Skills of Elementary School Children. *Research Quarterly,* March 1962, 33, 94-103.

17. McGraw, Myrtle B. *The Neuromuscular Maturation of the Human Infant.* New York: Hafner Publishing Company (reprint), 1963. (Original, Columbia University Press, 1945).

18. Rarick, G. Lawrence. *Motor Development During Infancy and Childhood.* Reproduced with permission of author by Extension Division, University of Wisconsin, 1954.

19. Sinclair, Caroline B. Ear Dominance in Preschool Children, *Perceptual and Motor Skills.* 1968, 26, 510.